

Objections to Staff's Analyses of Impairments to Water Resources – Malibu Lagoon (Tech Memo #4)

No.	Comment	Parties	Page #	Response
77	<p>Discharges of wastewater released from OWDS groundwater that is not in hydraulic connection with Malibu Lagoons transport a nitrogen load significantly in excess of the waste load allocation in TMDL. The information in the memo does not support a need for a prohibition on OWDS in the Civic Center area and the finding based on this memo is not supported by substantial evidence.</p>	City	107, 2 nd paragraph	<p>Staff prepared the draft Tech Memo # 4 using updated information from Regional Board permit files and information from the Stone Report, Questa Report, Tetra Tech Report, Los Angeles County Assessor Parcel Web Page, and several other technical sources as listed the references. Based on staff review of the information from all these sources, it was concluded that there is a direct correlation between the high level of nitrogen discharge through the OWDS and the levels found in the Malibu Lagoon because of hydraulic connection. Figure 1 of Tech Memo #4 page TM4-37 shows a simple model of soil layers and groundwater budget. The nitrogen species, discharged to the groundwater through the OWDS, transform through the different stages of the nitrogen cycle. Once nitrogen reaches the lagoon or the ocean, it converts to the most stable form as nitrate. The City's 2004 Stone Study concluded that there is a hydraulic connection and identified six-months-travel-time zone to lagoon.</p>
78	<p>Technical Memo does not demonstrate that nitrogen from OWDS is a significant source of impairment to aquatic life. ...</p> <p>The analysis did not consider loading of nitrogen from atmospheric sources...</p> <p>The memo does not show that a balanced scientific review was conducted by staff...</p>	City	107, 3 rd paragraph	<p>The purpose of Technical Memo #4 is to quantify the cumulative nitrogen load from OWDS to Malibu Lagoon and compare the results with the Malibu Creek Nutrient TMDL numerical target for nitrogen.</p> <p>The TMDL quantifies all sources of nitrogen loading to the Lagoon, including OWDS, Tapia WWRP, fertilizer application, runoff, nutrient cycling, and atmospheric deposition, and assigns allocations to these sources.</p> <p>Staff used the modeling results of groundwater flow nets to distinguish different hydraulic flow transports in the groundwater and develop a quantitative water balance for the groundwater system, identify the contributing area for the surf zone and the Lagoon, estimate groundwater travel time. Therefore, the estimates of nitrogen loads in different capture zones have scientific basis and are consistent with the results of existing groundwater and surface water model analyses. Staff also carefully evaluated the OWDS nitrogen loading using a scientific approach and a mass balance model to ensure the estimate of mass loading to the Lagoon is the best fit with actual conditions, including groundwater and surface loads, as documented in the Nutrient TMDL for the Malibu Creek Watershed.</p>
79	<p>The proper scientific method was also not followed in the analysis....</p>	City	108, 2 nd paragraph	<p>The Malibu Creek Nutrient TMDL, adopted by U.S. EPA on March 21, 2003, demonstrates that OWDS are a significant source of nitrogen in the Lagoon and affect aquatic life in the Lagoon. Tech Memo #4 demonstrates that current OWDS nitrogen loading causes continued exceedance of numeric targets and impairment of beneficial uses.</p>

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No.	Comment	Parties	Page #	Response
80	Staff uses models for its analysis, data and trends from the Stone (2004), Questa (2005), and Tetrattech (2003) reports, then applied its own conservative approach, ...	City	108, 3 rd paragraph	Staff used two approaches to estimate the mass loading to the Lagoon and then employed a mass balance model to evaluate which estimate of mass loading to the Lagoon is the best fit with measured data of nitrogen in the Lagoon. Each approach has its own assumptions; however, the final estimates were compared with actual field data to justify the assumptions. Thus, staff believes that the approaches used in the Tech Memo # 4 are appropriate and the assumptions have been verified with the measured data.
81	There were 349 residential homes in the study area. Prohibition area differs from boundaries of the Risk Assessment. It includes more homes.	City	110, 2 nd paragraph	Staff used the same boundaries as the Stone Report in the August draft of Tech Memo #4 and expanded to include coastal strips on Amarillo Surfrider Beaches as shown in Map 1 due to beach water quality impacts. Nutrients encourage bacteria growth. The original calculations in Tables 1 and 3 advertently exclude the coastal strip expansions. The number of homes has been adjusted to 392. The flow is 139,300 gpd.
82	Flow estimation: Residential flow is calculated by multiplying the number of bedrooms in each home for 100. "This is a faulty conclusion ..." Flow estimate is based on a series of unsubstantiated assumptions...Water delivery records shall be used - the calculations for residential use do not take into account the unique nature of Malibu that many of these residences are second homes and are not inhabited on a daily basis. This is especially true for the properties in the colony and along Malibu road.	City	110, 2 nd paragraph 171, Comment 1 172, Comment 13	This flow is very close to the estimated flow using two different approaches to calculate it: (a) A study of water use and onsite wastewater management needs utilized in-house surveys to derive an estimated water use of 142 gallons per capital per day (gpcd) (Peter Warshall and Associate, 1992 Malibu Wastewater Management Study (MWMS)). Based on the Census 2000, the average house hold size is 2.39 for the City Malibu. Therefore the number of houses (392) multiplied by the 2.39 and 142 gpcd results in a flow of 133,036 gpd. (b) The MWMS report indicates that the average water usage is on the order of 350 gallons per day per household. If we use this approach to calculate, the flow is 137,200 gpd (350x392). Staff estimated the flow using updated information. This updated information included a significant number of commercial dischargers who were not part of earlier studies.
83	The numerical fate and transport model is not explained... Therefore, the conclusion of the Tech Memo # 4 cannot be independently verified.	City	171, Comment 2	The previous fate and transport groundwater model developed by McDonald Morrissey Associates for the City was used for the estimate of mass loading to the Lagoon. The relationship between nitrogen mass loading from OWDS and to Malibu Lagoon was established by this previous model. Based on the estimate of mass loads from OWDS by Regional Board staff, the mass loads to the Lagoon can be obtained by this relationship. The detailed description of the estimate of nitrogen mass loadings to the Lagoon using this model was presented in the attachment 4-1 of Tech Memo # 4.

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84	The analytical (spreadsheet) fate and transport model is not explained... Therefore, the conclusion of the Tech Memo # 4 cannot be independently verified.	City	171, Comment 3	Staff provided the description of all factors considered in the analysis to estimate the percent of flow that may reach the lagoon and the ocean. The factors are: wastewater discharge location, surface topography, groundwater contours, soil and hydrology. Staff assumed that the flow contours depicted for the Malibu Valley in the 2004 Stone report were correct and we applied to the model.
85	No credible scientific basis is provided for estimation of the soil nitrogen load reduction factors (staff used values ranging from 0% to 20%). Therefore, the conclusion of the Tech Memo # 4 cannot be independently verified.	City	171, Comment 4	Staff used both credible scientific basis and information about the site (Table 3, TM4-32) to estimate the soil nitrogen load reduction. With expansion of the range to zero removable, staff used Table 3-19, page 3-29 of the USEPA Onsite Wastewater Treatment Systems Manual, February 2002 edition. Assigned percentage total nitrogen (TN) reductions were based on information about reported pumping and overflows, indicated failure, the vertical separation between the bottom of the leach field and groundwater elevation, and/or the use of seepage pits for disposal .
86	Staff's decision to not evaluate soil nitrogen load reduction for residential properties is indefensible. ...load rates of effluent hydraulic loading and waste strength loading..., natural nitrogen load reduction would be greater for residential properties than for commercial properties.	City	171, Comment 5	Disagree. For calculation of the residential nitrogen load, staff assigned a nitrogen load reduction (in-tank reduction) which is equivalent to typical leachfield reductions for residential discharges when the concentration level was reduced from 60 mg/L to 45 mg/L. Also, Regional Board staff considered that many of the Malibu coastal residents lack adequate separation between groundwater and many hillside residents use bedrock seepage pits for disposal, which do not provide natural nitrogen load reduction.
87	The analytical (spreadsheet) fate and transport model is not explained in any reasonable level of detail to allow technical review; model equation, model input, and the selection of input parameters are not described.	City	171, Comment 6	Staff has provided explanations for all the inputs of each parameter of the spreadsheet in Tech Memo # 4. No model equation and model input were used in the spreadsheet calculation. The spreadsheet shows the input for each calculation.
88	No discussion of the scientific basic for establishing a numerical threshold for nitrogen concentrations in receiving surface waters habitat with respect to the question of what aquatic toxicity endpoint is used to define impairment of aquatic life.	City	172, Comment 7	Staff provided in footnote 15, page TM4-15 in Tech Memo # 4, the numerical threshold for nitrogen concentration in the receiving surface waters. The discussion of the scientific basis for establishing a specific numerical threshold was provided in the TMDL.
89	Page 1 erroneously states that commercial development is concentrated on Malibu Road. While there are a small number of parcels, it would be better to state that it is centered on Civic Center Way instead.	City	172, Comment 8	Concur. Comment incorporated.

October 30, 2009

Objections to Staff's Analyses of Impairments to Water Resources – Malibu Lagoon (Tech Memo #4)

No.	Comment	Parties	Page #	Response
90	City does not have an Assessor. This reference should be to the Los Angeles County Assessor.	City	172, Comment 9	Concur. Comment incorporated.
91	Study of water usage on an assumption of 100 gpd per restroom. It would seem that the uses of low flow fixtures are more prevalent now and that a more accurate number would reflect such water conservation measure.	City	172, Comment 10	Staff corrected the text and tables in Tech Memo #4 to read 100 gpd for bedroom. This assumption of higher than national per capita usage is based on the cited references to both higher BOD and wastewater discharge volumes for luxury or affluent communities. Water consumption data from Water Works District 29 support per capita usage in the City of Malibu.
92	Area the total listed for current wastewater generated (128,469) accurate? It is not correct to say that there has been a 100% increase in use. The calculation was done in error. ...the percentage increase is not actually that high.	City	172, Comment 11	The revised flow number of 127,241 gpd was based on Regional Board updated information received from monitoring reports and Report of Waste Discharge (RoWDs) applications received for unpermitted sites in the area. Tech Memo # 4 paragraph 2 of page 6 stated that the 100% percent increase is only in comparison to the (2004) Stone report inventory, which is 62,166 gpd (Table 5, page TM4-14). Your comment is based in Tetra Tech report, which is 75,000 gpd (Table 5, page TM4-14).
93	Memo does not provide sufficient data regarding the information obtained on “site visits” to the unpermitted commercial establishments.	City	172, Comment 12 Page 2 of 6,	Information is available for public review in our office.
94	A statement is made that untreated wastewater is being discharged. By whom? Why is a portion of Pepperdine included when it is on sewer?	City	172, Comment 14	Staff has amended the statement to read “The wastewater discharged from commercial facilities in Sector 1 is a mixture of primary and secondary treated wastewater.” A portion of the Pepperdine University is included because inland boundaries were adjusted to correspond to watershed drainages. Also, the boundaries for the study area in the 2004 Stone Report were expanded to include coastal strips on Amarillo and Surfrider Beaches.
95	Staff gives various estimations of the percentage of flows that are reaching the lagoon from the various Sectors. What evidence are these assumptions based on?	City	172, Comment 15	Staff estimated these percentages of drainage based on groundwater contours and surface watershed drainages of the study area.
96	Staff states that Malibu Colony Plaza encompasses all the commercial area between PCH and Malibu Road. This statement is not true, because there is also the 76 Station, Post Office, Urgent Care, and abandoned gas station that are located in the specified area.	City	172, Comment 16,	Disagree. All these businesses are connected to the Malibu Colony Plaza WWTP.

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97	Clarification about the number of homes in sector IV and explanation about the sub-sectors.	City	173, Comment 17	The corrected total number of homes is 223. The sector was subdivided to estimate the contribution of this sector to the nitrogen load to the lagoon. Subsectors have a different drainage direction and therefore a different contribution to the nitrogen loading at Malibu Lagoon.
98	There is nothing but the Pacific Ocean south of Malibu Lagoon. The project document needs to include accurate directions throughout (i.e. PCH runs east – west and the ocean is to the south of the project area).	City	173, Comment 18	Concur. Correction made.
99	29 lbs/days of what is transported to Malibu Lagoon? Needed to be clarified.	City	173, Comment 19	Tech Memo #4 is about nitrogen load to the Lagoon. A revision to the nitrogen load was made after the number of homes and flow was corrected. 30.2 lbs/day of total nitrogen is transported to Malibu Lagoon.
100	Why is the last line in Table 4 different for the next load to Malibu Lagoon?	City	173, Comment 20	The last line in table 4 show results of the net load to Malibu Lagoon from different studies. It also includes the numeric and spreadsheet estimates by staff.
101	Reduction of nitrogen load from commercial facilities was not analyzed in the memo. Where were the new 15 OWDS installed?	City	173, Comment 21	Staff considered the nitrogen reduction from commercial facilities in the analysis as shown in the Tables. Tables 1 and 3 show the average effluent total nitrogen (TN) levels for those businesses with advanced OWDSs. Also, there are only 9 new OWDSs. 8 of 9 facilities were installed since 2004. The other facility, Malibu WWRP, was installed in 2001.
102	<p>Table 2 includes properties that are incorrectly categorized:</p> <p>APN 4458-027-037 is actually addressed as 3547 Winter Canyon and it contains a long standing commercial use – Malibu Glass. There is no multifamily development on that property.</p> <p>APN 4458-027-025 is an elementary school and does not contain a 6 bed, 6 bath residence.</p> <p>APN 4458-027-005 is a duplex, not a single-family residence. APN 4452-019-008 is a duplex, not a single-family residence.</p>	City	173, Comment 22	<p>Regarding APN 4458-027-037 according to the Los Angeles County Assessor database, this is the site of Malibu Vista Pacific Condominiums, located at 3601 Vista Pacific Unit 2. Wastewater from the site is discharged to the Malibu WWRP. This APN is not listed individually in Table 2. 3547 Winter Canyon Road, which is a multi-family residence, corresponds to APN 4458-027-034.</p> <p>Regarding APN 4458-027-025, staff will further investigate this site because the L.A. County Assessor database listed APN 4458-027-025 as a single family residence with 6 bedrooms and 6 bathrooms, but a view through Google Earth indicates that this may be a school.</p> <p>Staff concurs with your comments regarding APN 4458-027-005 and APN 4452-019-008.</p>

October 30, 2009

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103	Assumptions used in estimating nitrogen loading are explained ... it is most important to recognize that the assumptions result in estimates, not actual measurements of nitrogen loading. Therefore, the language in 2.b.iii that states what flows and loads are should be changed to document that based on the assumptions.	City	173, Comment 23	Acknowledged. Language is revised.
104	Water used data show that the amount of commercial wastewater discharge has actually gone down in the area that contributes to the lagoon....	City	173, Comment 24	Disagree. See Tech Memo # 4 Table 1 for flow information and RTC # 6.
105	Stone (2004) estimated average indoor water use as 500 gpd and 20 mg/L Nitrate-N, because a high volume of indoor water use resulted in diluted wastewater with relatively low nitrate-N concentration...However, the assumption of 1 person per bathroom and an average of 3.6 bathrooms per house (1,262 total bathrooms/349 Residential units) results in an exaggerated estimate ...	City	174, Comment 25	The tables used to characterize domestic wastewater in the textbooks cited already account for dilution. It is the very lowest residential TN loading value of 20 mg/L used in the Stone report that is not supported. In addition, the volume of residential wastewater estimated in the Stone report was essentially the same as used in Tech Memo #4. Staff provided several references that support the premises that luxury homes have a higher discharge volume.
106	The Technical Memorandum does not provide a rationale for the distribution of flow and does not provide any hydrologic data or analysis to support it...	City	174, Comment 26	The factors governing the flow contribution are listed in Tech Memo #4 (section cii, page TM4-9): wastewater discharge location, surface topography, and the groundwater flow contours. Staff used the groundwater flow contours for the Malibu Valley alluvium published in the 2004 Stone report. Water and wastewater flow downhill perpendicular to the elevation contours. Shallow groundwater flow in the bedrock areas follows topography.
107	The loading calculations done by LARWQCB should be recalculated using contributing area based on the region's actual hydrogeology. See the map titled Groundwater Wells and Groundwater Recharge Areas in Malibu Study Area in Appendix 4-1.	City	174, Comment 27	Appendix 4 in the 2004 Stone report consists of materials from stakeholder presentations. The major difference between our hydrologic model and the model used in the Stone report is that Stone assumes all bedrock highland flow discharges to the edges of the Malibu Valley groundwater basin. Staff agrees that much but not all of it does, especially in areas such as the west-side of the valley with low transmissivity sediments.
108	The statement is made that "Groundwater takes the path of least resistance", and then the memo attempts to present a case, without any evidence, that the groundwater will NOT take the path of least resistance. Rather it will travel through the bedrock instead of flowing directly to the ocean down a relatively steep gradient through the permeable alluvial along the trough of Winter Canyon...	City	174, Comment 28	Geologists for the Malibu Water Company targeted bedrock fracture areas for water supply wells after wells in the porous alluvium adjacent to Malibu Creek were found to be too susceptible to pollution. There is no statement in Tech Memo #4 that Winter Canyon flow traveled in bedrock and not alluvium.

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109	There was nothing in the Memo to indicate that the beach in front of Winter Canyon has ever been found to be contaminated by discharge from Winter Canyon...Winter Canyon should be deleted from the proposed Prohibition Zone. If contribution is indeed only 1% and may be ZERO, how does this miniscule contribute justify a prohibition? Longshore current drift from the mouth of Winter Canyon cannot enter the Lagoon, because the Lagoon is topographically higher than the ocean, and is typically blocked by a sand bar.	City	175, Comment 29	The Thomas Guide shows the mouth of Winter Canyon discharges to the ocean midway between Malibu and Amarillo Beaches. Amarillo Beach does not have a monitoring station for water quality. However, the 2003 USEPA TMDL for nutrients in the Malibu Creek Watershed estimated up to 5% of the nutrient load to Malibu Lagoon was derived from tidal inflow on the basis of earlier research (2000) by Ambrose. The estimate of one percent (1%) flow contribution from those sectors of the prohibition area may potentially reach to the Lagoon. Staff agrees with the USEPA's analysis that nutrient discharges to the ocean waters adjacent to Lagoon can contribute to the Lagoon nutrient load. Tidal exchange with the ocean is greater when the berm is open, but it still occurs even when the berm is closed.
110	Reference is made to the west side of Malibu Creek and Serra Retreat is on the east side of Malibu Creek.	City	175, Comment 30	Comment noted and correction made.
111	The analysis ignores nitrate loading from inflow of Malibu Creek to the Lagoon. Available data from Heal the Bay monitoring at Arizona Crossing shows that nitrate levels in Malibu Creek can be as high as 10 mg/L See the chart titled...	City	175, Comment 31.	TN concentrations at Arizona Crossing are due to high nutrient loads in the Upper Malibu Creek Watershed, and these loads are detailed in 2003 USEPA TMDL for nutrients. The total nitrogen load allocation for the Lagoon is 27 lbs/day from all sources. This is the load which has been calculated to limit nitrogen concentration in waters of the Lagoon to 1 mg/L. Reduction is required from all sources in the Malibu Creek Watershed to meet this load allocation.
112	The discussion of nitrogen loading is only a repetition of various estimates without discussion of why there are differences. The analysis is presented with no clear basis for the Board's choice of estimate, and without documentation of the procedure for making the estimate of how much nitrogen is produced...No consideration is given as to whether existing advanced treatment systems might change the assumed nitrogen production rates. This is a very hollow results section, difficult to quantitatively review because there is no substance in it available to review.	City	175, Comment 32	Disagree. "End-of-pipe" data is used including Septic system source in both Tables 1 and 3. Only a very small proportion of commercial flow and load is estimated. The totals are the result of simple addition.
113	The wording in the main body of Technical Memo #4 implies that the numerical model was used by Board staff to estimate loading rates; however, this is appears to not be true and the ratio of total nitrogen load was used to calculate the load to the lagoon.	City	175, Comment 33	The numerical model was used in addition to the spreadsheet model for comparison.

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114	The following statement is not clear: “Since 2004, 15 additional OWDS have been installed at commercial properties in the Malibu Civic Center area.” It would appear to more accurately be stated as follows: “Since 2004, 15 OWTS have been installed at existing commercial properties in the Malibu Civic Center area.”	City	175, Comment 34	Acknowledged. Tech Memo #4 reflects the revision that 8 OWTS have been installed since 2004..
115	Section 4-1, Pages 33. In Table 1 of the memo addendum by Lai, various loading rates are compared. Rather than using the correct contributing area for the lagoon the staff simply assumed that 50% of total nitrogen produced in the project area will go to the lagoon. This assumption is arbitrary and completely ignores the mapped capture zone for the lagoon. See the mapped capture zones presented in the map titled Groundwater Wells and Groundwater Recharge Areas in Malibu Study Area, in Appendix 4-1.	City	176, Comment 35	This table shows five estimates of nitrogen mass loading to the Lagoon including three prior third-party estimates. The assumption that 50% of total nitrogen loads from OWDS will go to the Lagoon was made by Tetra Tech as part of the previously adopted Malibu Creek Watershed Nutrients TMDL. Staff reviewed three prior estimates of mass loads to the Lagoon and considered the different capture zone, hydraulic conductivity, soil characteristics, and prior groundwater modeling results to determine direction of groundwater flow and to identify which parts of the study area contribute groundwater flow to the beach and to the Lagoon. Finally, staff used a mass balance model to evaluate which estimate of the mass loads is the best fit with the measured data of nitrogen concentration in the Lagoon. See the attachment of Tech Memo # 4 for the detailed description of Table 1 and related information.
116	The presumption that the OWDSs in Malibu are responsible for the pollution in the lagoon and in the beach area is not supported by facts. The pollution is more likely to be a result of large quantities of animal fecal matter from water fowl and from terrestrial animal waste that flows down into lagoon from tens of thousands of acres of watershed	WW Advisory Committee	187 paragraph 2	Acknowledged. See the (2003) USEPA TMDL for the nutrient load due to fecal matter from water fowl, and other animals such as horses in the Malibu Creek Watershed.

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No.	Comment	Parties	Page #	Response
117	<p>As previously referenced, Tech Memo # 4 indicates that the Winter Canyon Drainage (WCD) is not a source of Nutrients which contribute to impairments found in the Malibu Lagoon or Surfrider Beach.</p> <p>Lastly, we believe Tech Memo #4 contains a typographical error when it states, “Most of the wastewater discharged in Winter Canyon is assumed to discharge to Malibu Beach” [T4-9]. We believe the author meant to cite <i>Amarillo Beach</i> as the discharge point for Winter Canyon because there is ample evidence of this in the 2004 Stone Report and the 9/18/09 Earth Consultants International letter cited above. If indeed the author meant <i>Malibu Beach</i> then that assumption is not supported by any evidence...</p>	Colony Plaza	268, paragraph 3 & 4	Acknowledged. The mouth of the Winter Canyon drainage meets the ocean mid-way between designations of Amarillo and Malibu Beach.
118	<p>OWDSs are not the sole causative factor in the degradation of the water quality in Malibu Lagoon, but no other alternative causes are evaluated. Major conservative assumptions are made with respect to wastewater volumes passing through OWDS, bacterial and nutrient loads, groundwater flow velocities, and soil cleaning potential. Despite these large assumptions</p>	Latham & Watkins	439, paragraph 2	Tech Memo # 4 is focus on septic system nitrogen loads and compare water quality against TMDL for septic system. Other factors contributing to degradation were detailed in the (2003) USEPA TMDL for nutrients.
119	<p>The City has made considerable progress in regulating improvements in Civic Center (and City-wide) OWDS treatment systems in both residential and commercial systems. The Board fails to credit any of this progress by using outdated data</p>	Latham & Watkins	440, paragraph 4	Disagree. Existing OWDS site specific data was used including sites regulated by the City.

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120	<p>Individually, any single residence's OWDS contribution is minor compared to any single commercial discharge...</p> <p>The City's assignment of wastewater volumes based on 100 gallons per day per bathroom is outmoded and conservative...The overall water awareness campaigns, and the price of water, have all driven water usage volumes lower, resulting in lower wastewater discharge volumes or most new structures.</p>	Latham & Watkins	441, paragraph 2 & 3	<p>There are 392 residences and collectively the nutrient load discharged is significant. Staff is aware that low flow toilets and water conservation practices have reduced water usage and use 100 gpd instead of 150 gpd for luxury homes. Waterworks District #29 provided 2008 water usage data for the City of Malibu with estimates of the proportion of total usage that was used in the Malibu Civic Center area.</p>
121	<p>The Board states that 1% of my building's wastewater contributes to pollution in Malibu Lagoon. If in fact the building's discharge actually reaches the lagoon, the correct figure, based upon the Board's own calculations for the Malibu Civic Center area, is 0.004%.</p> <p>The Board states that my building's wastewater discharges directly to the ocean. This is patently wrong as my building is located two houses, a road and a beach from the ocean and the waste does not flow into a water table.</p>	Gerson	314, Comment 3	<p>Disagree. Taken alone the discharge from one small business has little impact. However, cumulative impact from all commercial and residential dischargers is problematic. All septic discharges in areas of shallow groundwater reach the water table, and the predominant flow in the discharge area is toward the ocean And only 1% may reach Lagoon along the coastline.</p>